

Fishery and Biology of the Yellowtail Snapper, *Ocyurus chrysurus*, from the Southeastern United States, 1962 Through 1996

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ABSTRACT

Yellowtail snapper, *Ocyurus chrysurus*, is an important reef fish in the western Atlantic Ocean supporting year round recreational and commercial fisheries. Primarily fished with hand lines and hook-and-line gear, the main fishery for the species in the United States occurs off southeast Florida and the Florida Keys. About 86% of the U. S. commercial landings since 1962 have come from Monroe County, Florida. Commercial and recreational landings throughout the fisheries harvesting the species increased from 1962 through 1993 and then decreased through 1996. Since 1988, the proportion of the total catches of the species that has been caught by the commercial fishery has increased significantly. Total landings of the commercial and recreational yellowtail snapper fisheries in 1996 were 39% and 82%, respectively, below the maximum levels observed over the period 1962 through 1996. Commercial CPUE levels for yellowtail snapper in 1996 for the Atlantic and Gulf of Mexico showed a decline of 82% and 52%, respectively. Declining relative effort trends for the species were observed since 1991 and 1994 for the recreational and headboat fisheries, respectively, along with declining catch estimates. We summarize known biological information, published life history parameters, and historical landings from commercial dealers, headboats, charterboats, private boats, and shore fishers. Identification of major landings areas and trends, seasonality patterns in catch, and CPUE trends in this report are important research components in future yellowtail snapper stock assessments.

KEY WORDS: Florida Keys, *Ocyurus chrysurus*, reef fish, stock assessment, yellowtail snapper

INTRODUCTION

The yellowtail snapper, *Ocyurus chrysurus* (Bloch, 1791), is a colorful tropical reef fish member of the snapper-grouper complex taken in commercial and recreational reef fisheries of the southeastern United States. The species is an important component of the shallow-water and reef associated ichthyofauna. In the Gulf of Mexico Exclusive Economic Zone (EEZ) they are managed under the Fishery Management Plan (FMP) for reef fish resources (GMFMC, 1981) and in the South Atlantic EEZ by the South Atlantic FMP for the snapper-grouper fishery (SAFMC, 1983).

Steady increases in yellowtail snapper commercial landings were observed until 1993 with a subsequent decline through 1996. Increasingly more restrictive regulations could have had an effect on recreational catches which have been in decline since 1992. Descriptions of the recreational and commercial fisheries, information on current trends in the catch, effort statistics, and relative abundance of the species are presented for United States waters of the western north Atlantic Ocean (North Carolina through Florida's east coast) and Gulf of Mexico (Florida Keys and Florida's west coast through Texas). This information is essential to proper management of this fishery.

METHODS

Life history information of the yellowtail snapper was obtained from computerized bibliographic databases that included Fishbase96 (Froese and Pauly, 1996) and Internet sources (Aquatic Sciences and Fisheries Abstracts, Current Contents, and Carl Uncovered), as well as from the "gray" literature.

Commercial fishery statistics, 1962 through 1996, for yellowtail snapper were obtained from port agents of the National Marine Fisheries Service (NMFS), Southeast Fisheries Science Center (SEFSC) and from data reported by wholesale seafood dealers to the Florida Department of Environmental Protection (FDEP). Recorded information included the total landings in pounds (lbs) by year, month, gear, and county. Landings from Florida and the Gulf of Mexico (Alabama through Texas) also included the area of catch, defined according to the NMFS statistical shrimp grid reporting system (Figure 1).

The number of commercial vessels in Florida since 1979 in the counties of Palm Beach, Broward, Dade, Monroe, Collier, and Lee operating with hook and line gear by county and year was used to index relative effort of the reef fish fishery and to calculate yellowtail snapper commercial catch per unit of effort (CPUE). All vessel counts were made by port agents. Only vessels from these counties were included as these counties dominated the commercial landings of yellowtail snapper (Figure 1). This information was used to provide an index of yellowtail snapper abundance for the commercial fishery. In addition, information on Monroe county commercial fishing effort was available through

1993 as another index of effort from the study of Bohnsack *et al.* (1994).

Information on the recreational catch of yellowtail snapper was taken from three sources. Harvest estimates from 1981 through 1996 for recreational anglers were obtained from the NMFS, Marine Recreational Fisheries Statistics Survey (MRFSS). These data included estimates of numbers and weight caught by years (in two month periods), state (North Carolina through Louisiana), and mode of fishing (shore, private, charter/headboat). MRFSS catch estimates are partitioned into three types of catches; (1) total number of fish killed ($A + B_1$), (2) number of fish released alive (B_2), and (3) number of fish killed and seen by an interviewer (A). Also, available from MRFSS for each stratum in which yellowtail snapper were caught was an estimate of the number of total trip hours expended by a charter, private boat, and shore fishers. These estimates were used as an index of relative fishing effort for the recreational shore, private, and charter fisheries and to calculate a relative index of recreational yellowtail snapper CPUE.

Recreational catches of yellowtail snapper from Texas were obtained from the Texas Parks and Wildlife Department (TPWD) Recreational Creel Survey (1986 - 1996) and MRFSS estimates (1981 - 1996). Information available for TPWD sport catches from boat modes included the year, wave (two month intervals), mode (headboat, charter, and private), number landed, and estimated trip hours.

Headboat fishery catch estimates were obtained from the NMFS Beaufort Laboratory Headboat Survey. Headboats, vessels that carry more than 30 passengers, have been surveyed in the Carolinas since 1976, the Florida Keys since 1978, and in the Gulf of Mexico since 1986. From 1981 through 1985, combined charter/headboat catches from MRFSS data in the Gulf of Mexico were used to document catches. Vessel captains reported numbers caught by year, month, and state. Weight of yellowtail snapper caught from headboats by year, month, and state was available using average weight estimate obtained from dockside or vessel samples and records of total headboat catch. In addition, for each year, month, and state stratum in which yellowtail snapper were caught the total number of angler days expended by all anglers was included. This information was used to calculate an index of relative CPUE for yellowtail snapper for the headboat fishery.

RESULTS

Life History

The yellowtail snapper (family Lutjanidae), is found extensively throughout the tropical western Atlantic shelf waters. Manooch (1984) roughly translates the scientific name, *Ocyurus chrysurus*, as "swift-swimming golden fish." Life

history profiles indicate the species is not well known (Fischer, 1978; Allen, 1985; Bortone and Williams, 1986; Froese and Pauly, 1996). Recent evidence from rearing, anatomical, genetic, and morphometric studies indicate the species may belong with the genus *Lutjanus* (Chow, 1992; Domeier and Clarke, 1992; Loftus, 1992; Sarver *et al.*, 1996; Clarke *et al.*, 1997), the new evidence substantially outweighing that for exclusion (Lindeman, 1997).

Yellowtail snapper range from Massachusetts (although rare north of the Carolinas) to southeastern Brazil, in Bermuda and the Bahamas, and throughout the Caribbean region. It inhabits coastal waters mostly around coral reefs, usually present in large aggregations well off the bottom. Most abundant in the Antilles, on the Campeche banks, and off the Florida Keys (Fischer, 1978; Allen, 1985), it is found to 180 meter depths over hard irregular bottoms such as coral reefs and near the edge of shoals and banks, as well as over wrecks and other artificial reefs. Tagging studies show little long-range adult movement (Beaumariage, 1969), but it is considered a semi-pelagic wanderer over the reef habitat (Moe, 1972).

Highly diverse in their food preferences, adults are described as euryphagic carnivores (Bortone and Williams, 1986) and feed primarily on a combination of plankton and benthic animals including fishes, crustaceans, worms, gastropods and cephalopods (Froese and Pauly, 1996). They feed mainly at night on prey found near the bottom, especially around reefs (Manooch, 1987). Larvae and juveniles feed selectively on the zooplankton (Boehlert, 1996).

The mode of reproduction in the yellowtail snapper is described as dioecism with external fertilization (Froese and Pauly, 1996). Fecundity estimates are reported from 0.038 to 1.39×10^6 eggs per gram (g) body weight (Collins and Finucane, unpubl.) for fish from the Florida Keys. Length at maturity is from 25 to 31 centimeters (cm) (Thompson and Munro, 1983; Allen, 1985), corresponding to an estimated age of one to two years for fish off south Florida (Johnson, 1997).

Continental populations are restricted batch spawners while insular components show year-round spawning (Grimes, 1987; Sadovy, 1996). Spawning occurs in open waters over reefs, banks and shelves. It seems to occur year round in Jamaica but mainly from January to April and August to October, from March to September off Cuba, during the spring and summer in the eastern Gulf of Mexico, and year round in the Florida Keys but mainly from April through August (Piedra, 1969; Claro, 1983a; Allen, 1985; Collins and Finucane, unpubl.). Even though spawning has not been observed, the large aggregations occurring in the Florida Keys during the summer are presumed spawning aggregations (Domeier and Colin, 1997). Courtship behavior for lutjanids is thought to culminate in an upward spiral with gametes released at the apex, apparently at dusk or night to coincide with spring tides at new and full

moons (Grimes, 1987; Sadovy, 1996).

Eggs of lutjanids are described as pelagic and like all reef fishes they have a pelagic larval dispersal phase (Richards and Lindeman, 1987; Richards *et al.*, 1994; Boehlert, 1996). At the end of planktonic life, yellowtail snapper larvae settle into shallow water nursery areas in sea grass beds inside and outside of barrier islands. At two to three cm and after one month of development, they migrate offshore to shallow reefs (Roberts, 1996; Lindeman, 1997). Larval and juvenile development, including daily growth stages, is described mainly from rearing studies (Riley *et al.*, 1995; Lindeman, 1997; Clarke *et al.*, 1997).

Population parameters have been summarized for yellowtail snapper from numerous studies around the region (Froese and Pauly, 1996). They are generally assumed to be long lived and slow growers except during the first year, and grow at a rate similar to other western Atlantic lutjanids (Manooch, 1987; Manooch and Drennon, 1987). The reported maximum age is five to eight years from Cuba (Piedra, 1969; Claro, 1983b), 14 to 16 years from the southeastern U.S. (Manooch, 1987; Johnson, 1983,1997), and 17 years from the Virgin Islands and Puerto Rico (Randall, 1968; Manooch and Drennon, 1987). The maximum ages for the Cuban fish could be underestimates because the capture methods target smaller fish.

Mean back-calculated total length-at-age estimates for yellowtail snapper have been reported from south Florida, Cuba, and the Virgin Islands and Puerto Rico (Claro, 1983b; Manooch and Drennon, 1987; Johnson, 1983,1997). These estimates vary from area and years, and differences could be related to food availability. Fish in southeast Florida in recent years apparently grow faster than those from previous studies and the Caribbean. Reported maximum length ranges from 55 cm fork length (FL) to 76 cm total length (TL) (Randall, 1968; Thompson and Munro, 1983; Manooch and Drennon, 1987; Johnson, 1983,1997). Estimated length in millimeters (mm) conversion equations were reported as $TL = -11.9747 + 1.2760 FL$ (Johnson, 1997), $FL = 17.7 + 0.78 TL$ (Johnson, 1983), and $TL = -0.8 + 1.266 FL$ (Thompson and Munro, 1983).

Reported von Bertalanffy growth parameters including asymptotic size (L_{∞}) ranges from 41 to 69 FL (cm), K ranges from 0.10 to 0.33, and t_0 ranges from -0.27 to -1.79 years (Froese and Pauly, 1996). Dennis (1991) estimated mortality rates (per year) from Puerto Rico where Z ranged from 0.865 to 1.148 and M was estimated as 0.321 using length-based methods, and Z ranged from 0.566 to 0.727 and M was estimated at 0.437 using age-based methods. Froese and Pauly (1996) summarized equations $\{L_{(cm)} = a \times \text{Weight}_{(g)}^b\}$ for converting length (cm) to weight (g). Coefficient a , ranging from 0.0145 to 0.0853, and b , ranging from 2.470 to 3.032 have been reported from Cuba, Jamaica, Puerto Rico and Virgin Islands, and the U.S.

Description of Fisheries

In the Gulf of Mexico and Atlantic reef fish fisheries, catches and landings for individual trips consist of multiple species. The snapper-grouper complex is one of the most important commercial and recreational fisheries of the southeastern United States (Huntsman and Waters, 1987). Reef fish fisheries extend from Cape Hatteras, North Carolina to Key West, Florida in the Atlantic and from Key West, Florida to Brownsville, Texas in the Gulf of Mexico, with extension fisheries operating throughout Florida. Reef fishes in the Florida Keys (Figure 1) have been fished for many years and effort has increased substantially over the period of the fishery (Ault *et al.*, 1998).

The current fisheries for yellowtail snapper provide both commercial and recreational opportunities in the shallow water coral reef region of south Florida. During the late spring and summer months these fisheries are intense in southeast Florida where large aggregations of yellowtail snapper are targeted on the outer reef tract around full moons. The current management plans for yellowtail snapper (DOC, 1997) include a combination of size and bag limits for recreational fishermen in federal waters of the Gulf of Mexico and Atlantic. These limits consist of a total of ten snappers in aggregate (excluding red, vermilion, and lane) per angler per day and minimum size limits of 12 inches (30 cm) TL. Commercial fishermen in federal waters are required to land fish with head and fins intact with a minimum size of 12 inches TL, and currently operate without a quota. Preliminary information on mean back-calculated total length-at-age estimates for yellowtail snapper from the southeastern U.S., 1991-1997, indicate the minimum size, 12 inches, is reached in one to two years (Johnson, 1997). Size and bag limits for Alabama, Florida, Louisiana, North Carolina, and South Carolina have compatible management measures while Texas, Mississippi, and Georgia do not have regulations in place for yellowtail snapper.

Many gears, including hook and lines (rod and reels, handlines, "yo-yos"), longlines, fish traps, trawls, trammel and gill nets, beach seine, dive gear, and bicycle type rigs (electric and hydraulic) have been used commercially to catch reef fish, including yellowtail snapper (GMFMC, 1981; SAFMC, 1983; Manooch and Drennon, 1987). Commercial fishers in the Florida Keys use secret mixtures for chum and specifically target large yellowtail snapper, commonly known as "flags," and primarily use handlines. Most of the Florida Keys commercial catch of yellowtail snapper is marketed locally, both fresh and frozen, but yellowtail snapper has a reputation for poor shelf life (Frimodt, 1995).

As is the case for commercial fisheries, the yellowtail snapper recreational fishery occurs primarily in the Florida Keys and along the southeast coast of

Florida. Inshore, recreational fishers use cut fish and squid while bottom fishing from bridges and piers. Offshore on the outer reef tract, anglers from small private boats and headboats catch yellowtail snapper over natural and artificial reefs. Some fishers attract them by baiting burlap bags and chum bags with finely chopped fish and then lower and raise the bag to attract schools to the boats (Manooch, 1984; Kelly, 1998). Night fishing for yellowtail snapper is common in the Florida Keys and southeast Florida waters. One of the snappers most desired by recreational fishers (Nakamura, 1976), the yellowtail snapper is pursued as a sport fish and is regarded as a quality food fish when consumed fresh (Manooch and Drennon, 1987).

Fishery Trends

The total combined recreational and commercial yellowtail snapper landings since 1981 are summarized in Table 1. MRFSS estimates of recreational landings represent an estimate of weight and probably are underestimated as samples of average weight did not exist for all strata in which there was an estimated catch. On an annual basis the amount caught but not sampled represented about 25,000-50,000 fishes. Total estimated landings of yellowtail snapper from all fisheries {commercial, recreational (shore, private, and charter) and headboat} in the Atlantic and Gulf of Mexico averaged 2.6 million pounds (lbs) per year (range from 1.8 to 4.2 million). 1996 estimated total landings of the commercial and recreational fisheries are 39% and 82%, respectively, below the maximum levels observed over the period 1962 through 1996, although estimated total landings prior to 1981 did not include landings from the recreational sector. Up until about 1987 the proportion of yellowtail snapper caught did not vary significantly between the recreational and commercial fisheries. Currently, the recreational fisheries take about 38.3% of the total weight landed. Total estimated combined annual landings varied without trend from 1981 through 1986, increased through 1991 to near 4.2 million lbs, however estimated combined landings declined by 55% from 1991 through 1996 to 1.9 million lbs. Total estimated value of the combined commercial and recreational fisheries was not determined because information on recreational value was unavailable.

Gulf of Mexico estimated combined recreational and commercial landings varied without trend through 1988, increased to 3.5 million lbs in 1991, and showed a consistent decline through 1996 to 57% of the 1991 total. The 1996 Gulf of Mexico total recreational and commercial landings was 44% of the 1991 maximum (Table 1). Atlantic estimated combined landings varied without trend from 1981 through 1998, showed increases from 1989 through 1993, and showed declines through 1996. The 1996 Atlantic total recreational and commercial landings was 62 % of the 1993 maximum (Table 1).

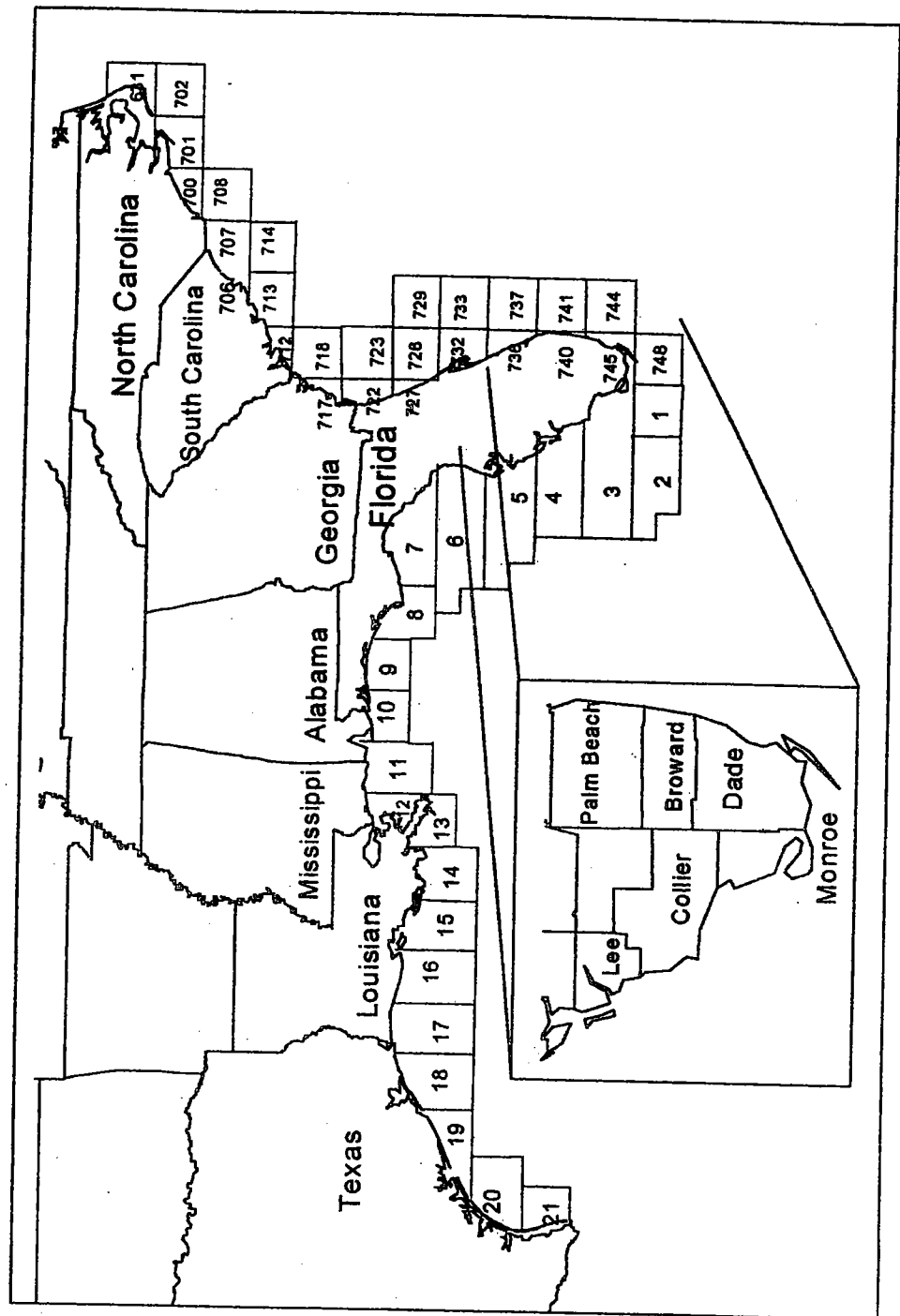


Figure 1. National Marine Fisheries Service (NMFS) Shrimp Grid map of the southeast United States used to describe specific catch areas and regions of landings of yellowtail snapper. Inset denotes major commercial and recreational counties of importance for yellowtail snapper.

Table 1. Estimated U.S. Atlantic Ocean and Gulf of Mexico yellowtail snapper combined commercial and recreational landings (pounds), 1981-1996, by state of landing. Data sources include National Marine Fisheries Service (NMFS) port agents, the Florida Department of Environmental Protection (FDEP), the Marine Recreational Fisheries Statistics Survey (MRFSS), NMFS Beaufort Headboat Survey, and the Texas Parks and Wildlife Department (TPWD).

YEAR	GULF OF MEXICO						ATLANTIC OCEAN					TOTAL ATLANTIC COMBINED
	Florida (west)	Alabama	Mississippi	Louisiana	Texas	TOTAL GULF	North Carolina	South Carolina	Georgia	Florida (East)	TOTAL ATLANTIC	
1981	1,850,360	838	0	0	0	1,850,998	0	0	0	346,907	346,907	2,197,905
1982	2,581,931	0	0	0	0	2,581,931	1,358	3,532	193	375,382	380,465	2,942,396
1983	1,425,168	0	0	0	29,288	1,458,436	0	31	0	332,772	332,803	1,791,239
1984	2,010,931	0	0	0	0	2,010,931	0	12	148	173,445	173,605	2,184,536
1985	1,339,944	0	0	2,198	0	1,342,140	0	9	0	648,908	648,915	1,991,055
1986	1,317,321	0	0	16	65	1,317,402	20	9	1	509,473	509,503	1,826,905
1987	1,877,802	1,383	0	0	8,352	1,878,985	0	3	319	423,491	423,813	2,302,798
1988	1,747,684	1,184	0	8	0	1,748,857	0	8	17	808,772	808,795	2,557,652
1989	2,989,498	1,352	0	1,886	0	2,972,734	0	172	0	450,084	450,238	3,422,970
1990	2,690,465	0	0	268	0	2,690,731	350	22	116	558,281	558,789	3,247,500
1991	3,495,000	0	0	44	2,776	3,498,840	2	189	0	854,981	855,152	4,151,792
1992	2,321,024	0	0	12	4	2,321,040	462	4,853	2	591,384	596,701	2,917,741
1993	2,749,239	0	0	54	0	2,749,293	401	203	40	849,715	850,359	3,599,652
1994	2,522,442	0	219	20	2	2,522,883	176	54	5	558,191	558,426	3,079,109
1995	2,145,007	0	0	40	0	2,145,047	81	160	0	378,736	378,977	2,524,024
1996	1,541,754	0	0	20	0	1,541,774	14	281	0	322,613	322,888	1,864,662

Commercial

Total commercial yellowtail snapper landings for the Atlantic Ocean and Gulf of Mexico averaged 1.3 million lbs (range from 0.7 to 2.4 million) per year from 1962 through 1996, with a peak occurring in 1993 (Table 2, Figure 2). Total ex-vessel commercial value averaged \$1.6 million per year (range from \$0.2 to \$5.02 million, Figure 2).

The commercial fishery is very concentrated geographically, with Florida west coast ports landing about 91% of the total commercial landings and Florida east coast ports about 8.8%. Most commercial landings from the Atlantic and Gulf of Mexico come primarily from a very localized area off Florida (Figures 1, 3a,b). Major counties of landings on Florida's east coast are Dade, Broward and Palm Beach, with Dade predominant. Florida west coast landings are primarily from Monroe county, followed by Collier and Lee counties (Figure 1).

Gulf of Mexico commercial landings varied without trend from 1962 through 1985 except for a high in 1982, increased from 1986 through 1993, and have shown a consistent decline in all years since. Atlantic landings varied without trend from 1962 through about 1987, increased slightly through 1993, and have also shown modest declines since (Table 2, Figure 2).

The dominant gear used in the commercial fishery is hook and line which accounts for about 93% of the total weight landed. Landings for both the Gulf of Mexico and Atlantic (all years combined) show a significant increase between March and June (peak in June with 15%) of about 50% and a subsequent sharp decline from July through February (Figure 4).

Recreational

The estimated catch of yellowtail snapper by the recreational sector is dominated by private boat (66.2%) and headboat (19.8%) anglers and averaged about 930,000 fish per year (range from about 445,000 to 1,679,000) for both the Gulf of Mexico and Atlantic combined (Table 3a, Figure 5a,b). As with commercially caught fish, the Florida Keys (Monroe county) and Dade county from the Florida east coast are the primary areas for the recreational sector (Figure 1). Estimated numbers of yellowtail snapper caught have been extremely variable over the years (Table 3a).

Gulf of Mexico estimated recreational catch of yellowtail snapper was highest from 1981 through 1984 (averaging 1.5 million fish per year), decreasing from 1985 through 1988 (about 430,000 to 526,000 fish), increasing to 1.1 million fish in 1991, then again decreasing by 66% to about 349,000 fish in 1996 (Table 3a). Estimated Atlantic recreational catch was variable over the entire period, particularly from 1981 through 1988 (ranging from about 93,000 to 422,000 fish), increasing to 275,000 fish in 1993, and subsequently declining by 65% to 96,000 fish in 1996 (Table 3a). The 1996 recreational yellowtail

snapper catch by shore, charter and private boat anglers was 81% below that estimated at the peak (1984). The 1996 headboat catch was 53% below that reported for 1988, the peak year.

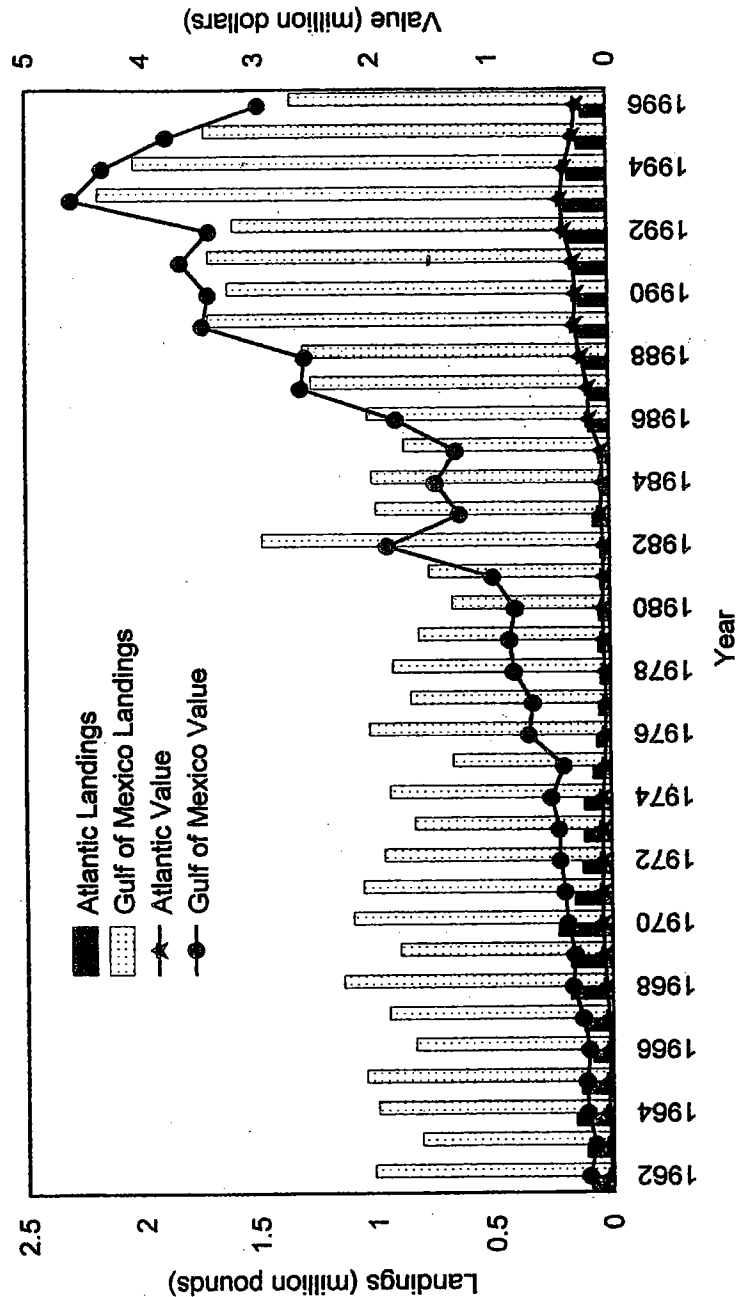


Figure 2. Yellowtail snapper commercial landings (pounds) and ex-vessel value (dollars) from the U.S. Atlantic Ocean and Gulf of Mexico, 1962-1996.

Table 2. Reported U.S. Atlantic Ocean and Gulf of Mexico yellowtail snapper commercial landings (pounds), 1962-1996, by state of landing. Data sources include National Marine Fisheries Service (NMFS) port agents and the Florida Department of Environmental Protection (FDEP).

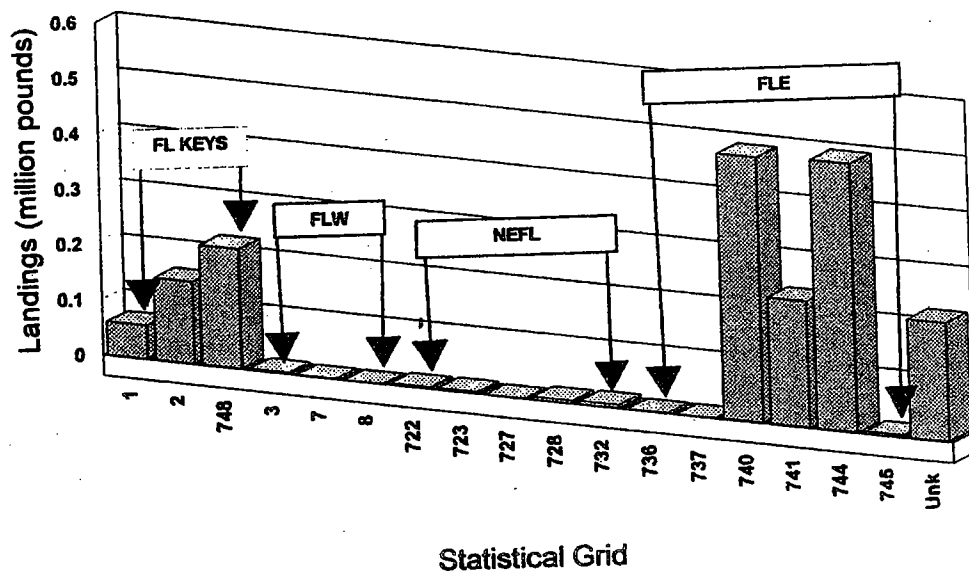
YEAR	GULF OF MEXICO							ATLANTIC OCEAN					TOTAL COMBINED
	Florida (West)	Alabama	Mississippi	Louisiana	Texas	TOTAL GULF		North Carolina	South Carolina	Georgia	Florida (East)	TOTAL ATLANTIC	
1962	1,009,878	0	0	0	0	1,009,878		0	0	0	98,013	98,013	1,107,891
1963	809,180	0	0	0	0	809,180		0	0	0	113,997	113,997	923,187
1964	986,115	0	0	0	0	986,115		0	0	0	159,851	159,851	1,155,066
1965	1,045,287	0	0	0	0	1,045,287		0	0	0	136,530	136,530	1,181,817
1966	835,275	0	0	0	0	835,275		0	0	0	86,247	86,247	921,522
1967	943,389	0	0	0	0	943,389		0	0	0	124,986	124,986	1,068,375
1968	1,138,083	0	0	0	0	1,138,083		0	0	0	180,819	180,819	1,318,902
1969	896,658	0	0	0	0	896,658		0	0	0	180,153	180,153	1,078,811
1970	1,095,459	0	0	0	0	1,095,459		0	0	0	232,323	232,323	1,327,782
1971	1,053,278	0	0	0	0	1,053,278		0	0	0	160,284	160,284	1,213,563
1972	960,705	0	0	0	0	960,705		0	0	0	127,317	127,317	1,088,022
1973	829,281	0	0	0	0	829,281		0	0	0	118,881	118,881	948,162
1974	934,287	0	0	0	0	934,287		0	0	0	116,439	116,439	1,050,726
1975	670,884	0	0	0	0	670,884		0	0	0	77,266	77,266	748,140
1976	1,023,753	0	0	0	0	1,023,753		0	0	0	61,494	61,494	1,085,247
1977	846,047	0	0	0	0	846,047		0	0	0	51,440	51,440	897,487
1978	921,650	0	0	0	0	921,650		0	0	0	44,549	44,549	966,199
1979	811,919	0	0	0	0	811,919		0	0	0	53,625	53,625	865,444
1980	673,062	0	0	0	0	673,062		0	0	0	50,080	50,080	723,152
1981	770,409	0	0	0	0	770,409		0	0	0	41,500	41,500	811,909
1982	1,481,520	0	0	0	0	1,481,520		1,358	0	0	39,784	41,142	1,522,662
1983	992,592	0	0	0	0	992,592		0	0	0	74,881	74,712	1,067,304
1984	1,011,714	0	0	0	0	1,011,714		0	31	0	39,566	39,726	1,051,440
1985	870,178	0	0	757	0	870,933		0	12	148	45,594	45,803	916,536
1986	1,028,466	0	0	16	0	1,028,472		0	9	0	82,318	82,348	1,118,820
1987	1,265,459	1,383	0	0	8,352	1,268,842		20	8	1	88,544	88,863	1,355,705
1988	1,299,430	1,184	0	9	0	1,300,623		0	0	319	111,836	111,863	1,412,576
1989	1,711,275	1,352	0	1,878	0	1,714,508		0	0	0	137,021	137,021	1,851,527
1990	1,627,159	0	0	218	0	1,627,377		0	18	116	128,102	128,236	1,755,613
1991	1,711,518	0	0	40	1,180	1,711,558		109	72	0	148,832	148,904	1,860,462
1992	1,602,741	0	0	12	0	1,602,753		378	4,707	2	169,981	174,799	1,777,552
1993	2,192,687	0	0	54	0	2,192,741		176	36	40	185,622	186,074	2,378,815
1994	2,036,637	0	219	20	0	2,036,876		52	14	5	168,409	168,604	2,205,480
1995	1,729,062	0	0	40	0	1,729,102		14	32	0	127,744	127,828	1,856,930
1996	1,348,571	0	0	20	0	1,348,591		0	102	0	108,825	108,941	1,458,532

Table 3. U.S. Atlantic Ocean and Gulf of Mexico yellowtail snapper recreational harvest, 1981-1996: a). estimated numbers caught and b). estimated weight (pounds) caught by state landed. Data sources include the Marine Recreational Fisheries Statistics Survey (MRFSS), National Marine Fisheries Service (NMFS) Beaufort Headboat Survey, and the Texas Parks and Wildlife Department (TPWD).

a). Numbers of fish													
YEAR	GULF OF MEXICO					ATLANTIC OCEAN					TOTAL		
	Florida (West)	Alabama	Mississippi	Louisiana	Texas	North Carolina	South Carolina	Georgia	Florida (East)	TOTAL ATLANTIC	TOTAL GULF	TOTAL ATLANTIC	TOTAL COMBINED
1981	1,333,705	814	0	0	0	0	0	0	344,502	344,502	1,334,519	344,502	1,679,021
1982	1,173,319	0	0	0	0	0	3,697	0	417,679	422,253	1,173,319	422,253	1,595,572
1983	558,545	0	0	0	31,758	0	0	0	186,782	186,782	590,301	186,782	787,083
1984	1,475,698	0	0	0	0	0	0	0	110,238	110,238	1,475,698	110,238	1,585,934
1985	427,546	0	0	1,086	0	0	0	0	343,184	343,184	427,546	343,184	771,798
1986	413,259	53	0	0	45	0	0	0	133,756	133,756	413,259	133,756	547,113
1987	606,341	619	0	0	0	0	3	0	92,708	92,712	606,341	92,712	699,053
1988	526,657	37	0	0	0	0	5	0	253,503	253,508	526,657	253,508	780,202
1989	743,258	0	0	0	0	0	131	0	117,395	117,528	743,258	117,528	860,786
1990	883,725	213	0	31	637	285	5	0	165,425	165,695	883,725	165,695	1,049,420
1991	1,022,051	4	0	4	0	341	114	0	191,863	191,978	1,022,051	191,978	1,214,030
1992	521,157	97	0	0	3	11	75	0	209,426	209,426	521,157	209,426	731,141
1993	601,063	286	0	0	0	0	28	0	275,089	275,089	601,063	275,089	876,153
1994	520,864	727	0	0	5	0	40	0	188,962	188,962	520,864	188,962	711,586
1995	474,508	3	0	0	0	8	40	0	109,169	109,218	474,508	109,218	583,730
1996	349,056	212	0	0	0	0	36	0	96,160	96,196	349,056	96,196	445,252

b). Weight in pounds													
YEAR	GULF OF MEXICO					ATLANTIC OCEAN					TOTAL		
	Florida (West)	Alabama	Mississippi	Louisiana	Texas	North Carolina	South Carolina	Georgia	Florida (East)	TOTAL ATLANTIC	TOTAL GULF	TOTAL ATLANTIC	TOTAL COMBINED
1981	1,076,951	638	0	0	0	0	3,532	183	305,407	305,407	1,080,589	305,407	1,385,996
1982	1,080,411	0	0	0	0	0	0	0	258,081	258,081	1,080,411	258,081	1,338,492
1983	435,576	0	0	0	25,268	0	0	0	133,879	133,879	435,576	133,879	569,455
1984	989,217	0	0	0	0	0	0	0	603,312	603,312	989,217	603,312	1,592,529
1985	469,768	0	0	1,438	0	0	0	0	417,155	417,155	469,768	417,155	886,923
1986	290,865	0	0	0	65	0	0	0	334,947	334,950	290,865	334,950	625,815
1987	612,143	0	0	0	0	0	3	0	696,838	696,842	612,143	696,842	1,308,985
1988	448,234	0	0	0	0	0	172	0	313,043	313,043	448,234	313,043	761,277
1989	1,258,221	0	0	7	0	350	4	0	428,179	428,533	1,258,221	428,533	1,686,754
1990	1,063,308	0	0	48	1,586	2	97	0	506,149	506,248	1,063,308	506,248	1,569,556
1991	1,783,482	0	0	4	0	353	146	0	664,093	664,285	1,783,482	664,285	2,447,767
1992	718,283	0	0	0	4	25	167	0	387,782	387,822	718,283	387,822	1,106,105
1993	558,552	0	0	0	2	0	40	0	260,992	261,149	558,552	261,149	819,701
1994	485,805	0	0	0	0	29	128	0	213,768	213,947	485,805	213,947	699,752
1995	415,945	0	0	0	0	0	159	0	0	0	415,945	0	415,945
1996	192,183	0	0	0	0	0	0	0	0	0	192,183	0	192,183

a.) Atlantic Ocean area of catch



b.) Gulf of Mexico area of catch

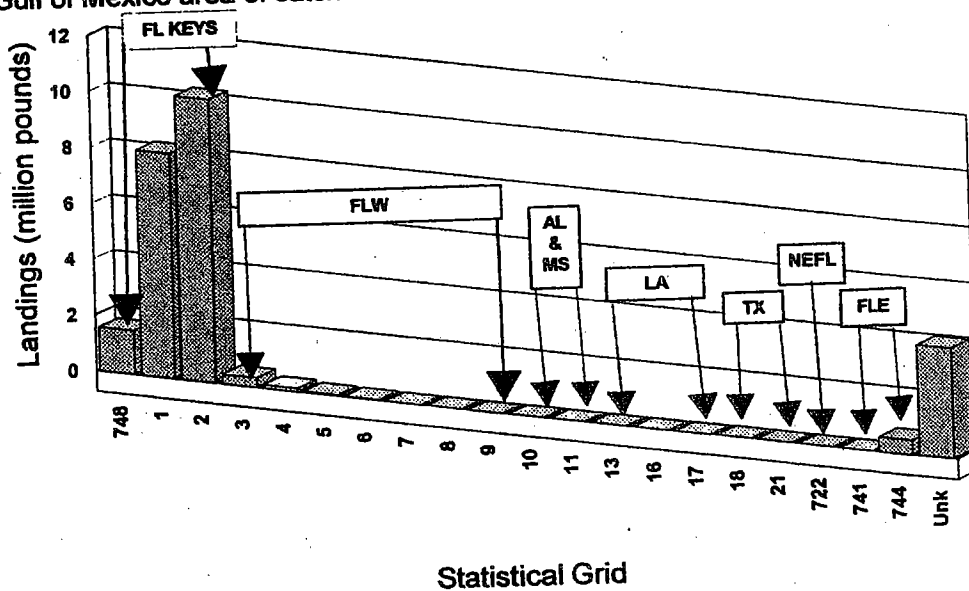


Figure 3. Distribution of yellowtail snapper commercial landings (pounds) by area of catch from the a). U.S. Atlantic Ocean and b). Gulf of Mexico by National Marine Fisheries Service (NMFS) Shrimp grids, 1977-1995. AL = Alabama, FLE = Florida (east), FLW = Florida (west), FL Keys = Florida Keys, LA = Louisiana, MS = Mississippi, NEFL = Northeast Florida, TX = Texas.

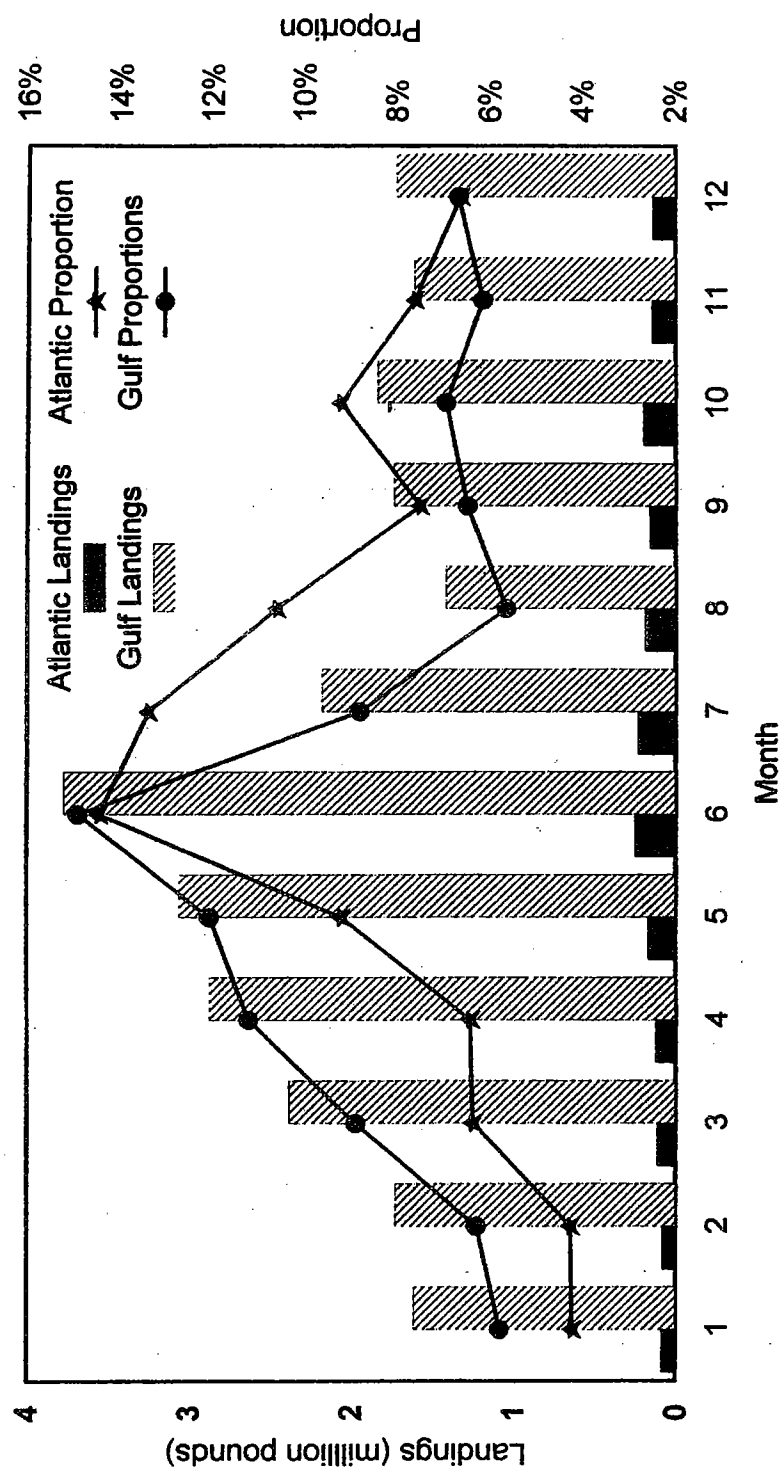


Figure 4. Distribution of yellowtail snapper commercial landings (pounds) by month from the U.S. Atlantic Ocean and Gulf of Mexico, 1962-1996.

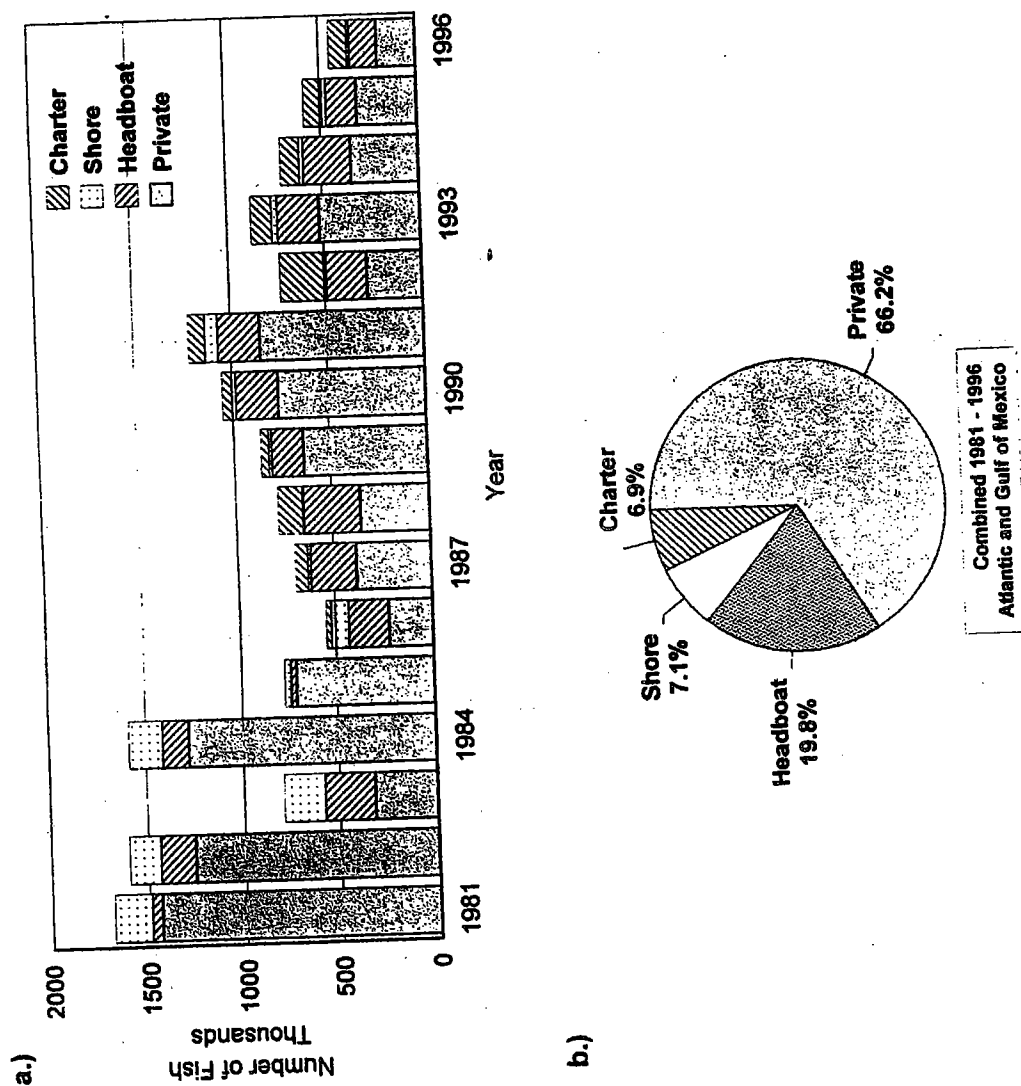


Figure 5. Estimated recreational catch (numbers) of yellowtail snapper, 1981-1996 from the southeastern U. S. (Atlantic and Gulf of Mexico combined) by a) year and b) fishing mode.

Total estimated recreational catch in weight averaged about 1.1 million lbs from 1981 through 1996, varying without trend through about 1985, increasing from 1986 through 1991, and showing a strong decline since 1992 (Table 3b). The 1996 combined Atlantic and Gulf of Mexico estimated recreational weight landed is about 55% lower than that of 1991. These results support a declining trend in recreational catch of yellowtail snapper both in terms of numbers caught and weight landed in both the Atlantic and the Gulf of Mexico.

Trends in Relative Effort and CPUE

Counts made by port agents of the number of south Florida commercial reef fish vessels using hook and line gear were used to evaluate trends in abundance of yellowtail snapper. The total number of reef fish commercial hook and line vessels was stable in the Atlantic at about 20-30 vessels from 1979 through 1989, increased to about 75 vessels in 1990, then sharply increased to more than 100 boats by 1993, and again to 200 boats by 1995 (Figure 6). The number of reef fish commercial vessels operating hook and line gear in the Gulf of Mexico was much higher than in the Atlantic, ranging from about 350 to 600 vessels over the period. Relative CPUE of Atlantic caught yellowtail snapper varied without trend from 1979 through 1989 and has declined consistently since 1989. However, yellowtail snapper landings in the Atlantic only showed a slight decline (Figure 6). Although Gulf of Mexico hook and line vessel effort was variable without trend since 1979, yellowtail snapper landings have increased significantly over the same period, and relative CPUE showed more distinct trends than did relative effort. Yellowtail snapper relative CPUE increased slightly from 1979 through 1992, showed a significant increase in 1993, with a strong declining trend of about 50% through 1995 (Figure 6).

The recreational sector has shown an overall decline in yellowtail snapper relative CPUE from the MRFSS (shore, private and charter) data. Since 1991, a decline in total relative fishing effort in the southeastern U. S. from an estimated 18 million angler trips to an estimated 11 million trips was observed (Figure 7a). A decline in total harvest is also seen since 1991. In the headboat fishery there were two recent periods of significant decline in yellowtail snapper relative fishing effort (estimated angler days), 1990-1992 and 1994-1996 (Figure 7b). However, headboat catch of yellowtail snapper declined only during this second period.

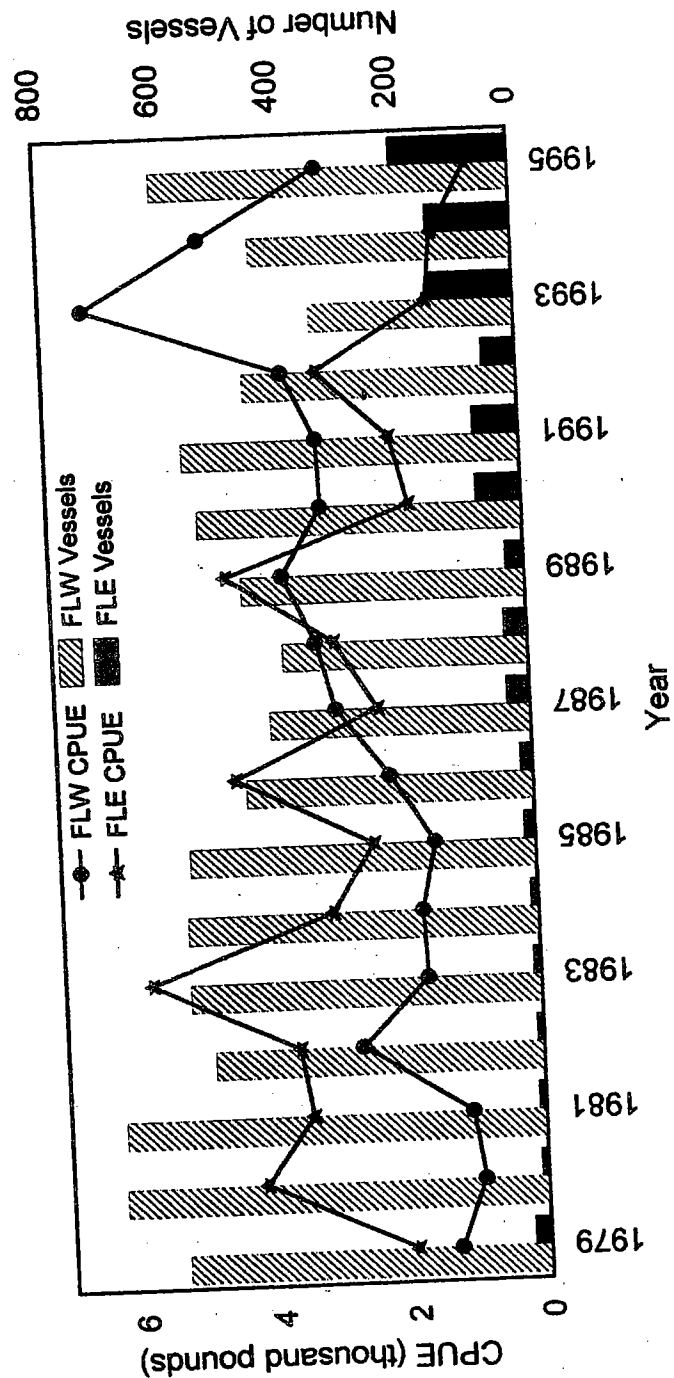


Figure 6. Reported yellowtail snapper landings, relative fishing effort, and estimated yellowtail snapper catch per unit effort (CPUE) trends for commercial hook and line reef fish vessels off the Florida east coast (FLE) and west coast (FLW), 1979-1995. Dade, Broward, and Palm Beach counties comprise FLE and Collier, Lee, and Monroe comprise FLW.

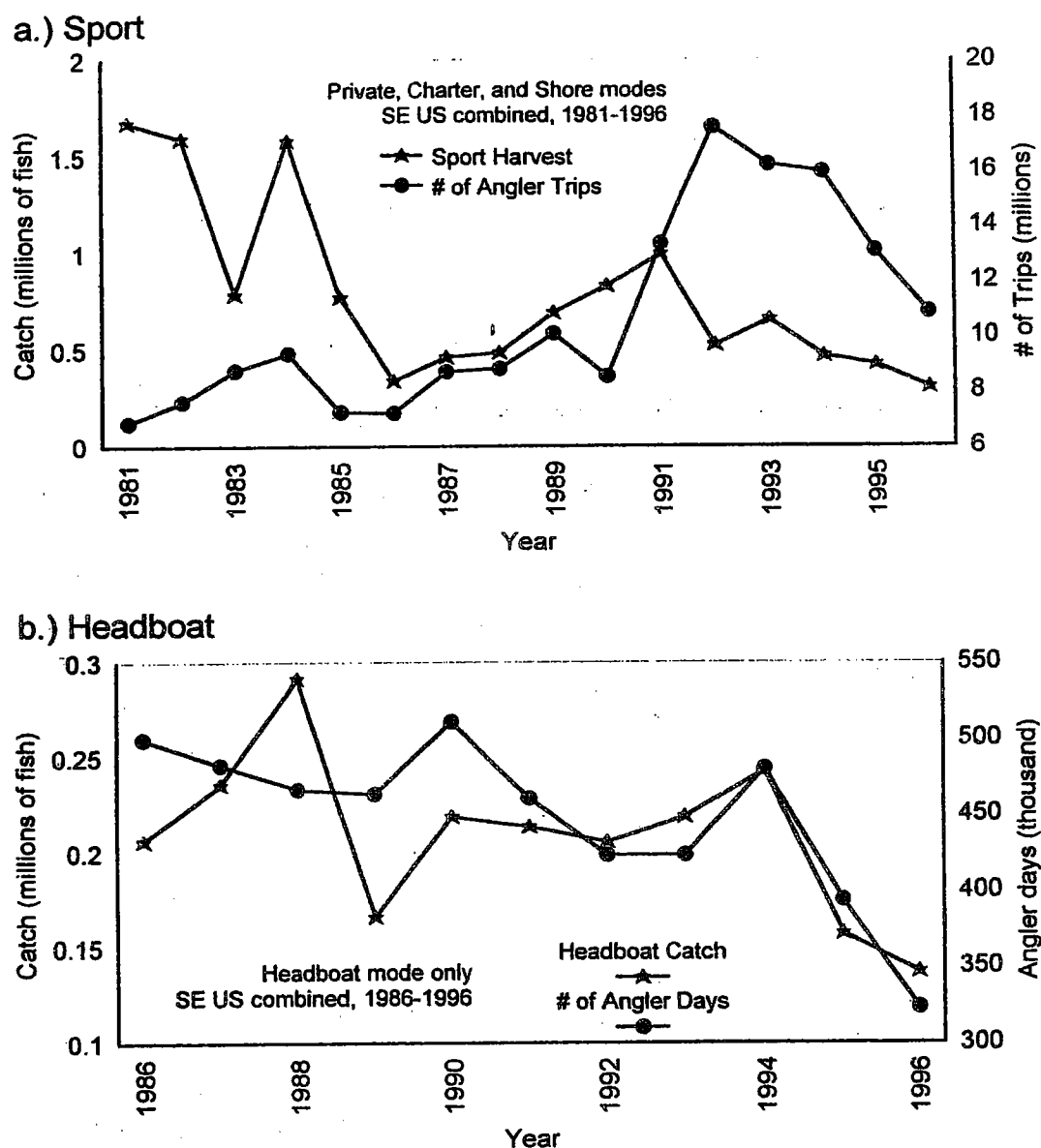


Figure 7. Total estimated U.S. (Atlantic and Gulf of Mexico combined) yellowtail snapper recreational catch (numbers), effort, and estimated catch per unit effort (CPUE) for a) sport (charter, private, and shore) fisheries 1981-1996 and b) headboat fisheries, 1986-1996.

DISCUSSION

Zhao *et al.* (1997) discussed the effects of overfishing on a closely related reef fish species, the vermilion snapper (*Rhomboplites aurorubens*), and indicated caution should be used when growth parameters derived from an overfished population are used to evaluate biological impacts of fisheries management actions. Current life history parameters for yellowtail snapper, including age and size compositions, may have changed due to changes in fishing pressure. Published parameters from this region, as well as from the Caribbean, may not be representative of the present stock(s). Fishing on spawning aggregations, which hasn't been confirmed but is thought to occur (Domeier and Colin, 1997), could have an effect on not only future year class strength but also on the genetic makeup of future generations. Fishery closures during the presumed major spawning times or known aggregation areas in the summer could be a possible protective measure.

Activities which are not related to fishing may have changed the behavior of yellowtail snapper, ultimately affecting harvest. Fish traps were banned in Florida state waters in October 1980 and Atlantic federal waters in January 1992. As a result, the numbers of large predatory fish, such as groupers, barracudas, and snappers, are believed to have increased. Yellowtail snapper abundance may have decreased since these large predators prey on yellowtail. Behavior of the species may also be changing in part due to tourism related activities. Divers on the reefs routinely feed yellowtail snapper non-traditional food such as "Cheez Whiz" from the can, and chum used for attraction by many fishers has increased. These concentrate the fish whenever a vessel approaches the reef and makes them easier to catch.

Sport fishing pressure in Florida waters has had an impact on fish stocks. Bortone and Williams (1986) and Bohnsack *et al.* (1994) reported a steady rise in recreational vessels registered in Monroe county, where the greatest harvest occurs. This study however, supports a recent trend in declining recreational harvest of yellowtail snapper since 1992, as well as a decline in relative fishing effort. Declines in recent commercial landings of yellowtail snapper, increasing relative effort, and recent declines in commercial abundance were shown. The disparity in relative fishing effort between the recreational and commercial fisheries needs to be investigated. Ault *et al.* (1998) performed a fishery independent multi-species assessment of coral reef fish stocks in the Florida Keys based on data (1979 through 1996) collected by the Reef Fish Team of the NMFS, and reported an overall decline in the Florida Keys reef fish stocks.

Research needs for yellowtail snapper include quantifying the total size composition of the recreational and commercial catch, proportioning total effort into that directed towards targeting yellowtail snapper, updating the age and growth and reproductive schedules, and investigating juvenile recruitment.

Unreported commercial sales of catch (directly to stores, restaurants, homes, etc.), unknown recreational sales and non-reporting, and lack of catch data from night fishing by sport fishers are known problem in the landings statistics. Information on directed recreational yellowtail snapper fishing effort is needed to corroborate the declining trend in recreational effort. Significant commercial landings and high recreational catch estimates from states other than Florida seem to be anomalous and need further corroboration.

Stock size trends are not yet available for yellowtail snapper and impacts on future landings and abundance from continued increases in commercial fishing effort are unknown. Recent declines in commercial landings in both the Atlantic and the Gulf of Mexico, increasing relative effort and declines in relative commercial CPUE, and the disparity in trends in the recreational fishery strongly supports the need for more research. The recently established Florida Keys National Marine Sanctuary implemented no-take zones in July 1997 and may provide interim relief to the species. A stock assessment using recreational and commercial landings data derived here, size samples of the catch, updated growth information, and estimates of stock size trends for yellowtail snapper in the southeastern U. S. could be applied to quantify stock condition from these catch-effort and biological data.

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